science arranged in logical sequence; it is a guide to the student and the investigator (for in chemistry these two are one); and it is full of suggestions alike to the physicist and the chemist.

That part of the second volume which deals with the recent developments of the study of chemical affinity will probably be found by many to be the most interesting portion of the book. Everyone knows how unsatisfactory is the treatment of this subject in the standard text-books. Who has not been perplexed as he attempted to gain clear conceptions about affinity? Affinity is one of those terms that escape one as soon as one tries to grasp it: it is protean, and each form which it assumes scarcely lasts long enough for one to distinguish it from the others.

The work of Guldberg and Waage, published twenty years ago, did not bring forth much fruit for some time; perhaps because these naturalists were obliged to go back sixty years to find in the writings of Berthollet the germs of a really exact treatment of the subject of affinity. But within recent years great advances have been made—and made, speaking broadly, on the lines laid down by the Norwegian professors. No one has had more part in these advances than Ostwald; to him we are indebted for several new experimental methods for finding values for the affinity-constants of acids and bases—indeed the proof of the existence of a measurable affinity-constant for each acid and base is, for the most part, due to him. It is one thing to know that memoirs are to be found in the journals wherein the subject of affinity is gradually advanced stage by stage, but it is quite another thing to have a clear, logically arranged, and condensed account of these memoirs in a text-book. It is one thing to be told that the modern development of affinity is the outcome of the views which Berthollet published, in 1803, in the *Essai de Statique Chimique;* it is quite another thing to have this historical and logical development set before one in detail in a masterly manner.

The subject of affinity is largely involved in the wider conception of chemical equilibrium. Ostwald gives a short account of the attempts which have been made to formulate the laws of chemical equilibrium. He then narrows the meaning of affinity, at least as applied to acids and bases; by doing this it becomes possible to extricate the notion of affinity from the mass of more or less connected facts which had threatened to swamp it, and to give it a quantitative meaning.

The affinity-constants of acids and bases are numbers which tell how much of a definite chemical action those bodies are capable of performing under definite conditions. The formulæ of the same acids and bases exhibit the composition of definite masses of these compounds, which masses are in many respects chemically comparable. The goal of chemistry has always been to trace definite connections between the composition of bodies and their chemical properties; but of all the chemical properties of a body the most important is its affinity-constant, inasmuch as we are apparently justified in saying that this value quantitatively conditions all the chemical reactions in which the body takes part: hence the importance of accurately tracing the connections between the changes of compositions of bodies, as represented by their formulæ, and the variations in the values of the affinity-constants of these bodies, must be very great. The data are as yet insufficient to allow of more than a beginning in this direction: such a beginning is made in the last chapter of Ostwald's book.

To everyone who hopes to make chemistry the business of his life I would say—get Ostwald's "Lehrbuch," read it, study it, become acquainted with it, use it; for by doing this you must become more fitted for doing your work as a chemist.

M. M. PATTISON MUIR.

BRITISH AND IRISH SALMONIDÆ.

British and Irish Salmonidæ. By Francis Day. 12 Plates. (London and Edinburgh: Williams and Norgate, 1887.)

IN this work Mr. Day expounds in greater detail the views he made known in his "British and Irish Fishes," concerning the characters and affinities of the several British forms belonging to the genus Salmo. He also includes in the volume the consideration of many other important problems connected with the natural history of British Salmonoids. On p. 9 he gives a synopsis of the British genera of the family, viz. Salmo, Thymallus, Coregonus, Osmerus, and Argentina, and then proceeds to consider Genus 1, Salmo, while at p. 278, is the heading Genus 2, Thymallus, Cuvier. For the designation of species and varieties English names are generally used, but with each is given a copious list of the Latin Linnean synonyms, and references to the works where they occur. The species considered are as follows: the Salmon, Trout, British Char, American Char or *Salmo fontinalis*, and the Grayling. Thus Coregonus, Osmerus, and Argentina are left outside the scope of the book, notwithstanding its comprehensive title.

Very elaborate descriptions, including enumerations and dimensions, are detailed for each separate form, but concise diagnostic analysis is entirely wanting. In the synopsis of species of Salmo given in the earlier work, "British and Irish Fishes," we find that the only trustworthy specific character differentiating *Salmo salar* from *Salmo trutta* is the presence in the former of eleven rows of scales in an oblique row from the adipose fin to the lateral line, all forms of *Salmo trutta* having fourteen or more of such scales. In the work before us one has to wade through two pages and a half of description of the salmon before reaching a mention of this diagnostic feature.

The views here expressed concerning the forms of sea-trout are somewhat different from those published in the "British and Irish Fishes." In the latter work Mr. Day described *Salmo trutta* and two varieties, *S. albus* and *S. cambricus*. In the present he describes *Salmo albus* (with the same synonymy) as the immature stage or grilse of the northern sea race of trout, *S. cambricus* being the southern sea race. Here again the want of a short diagnosis of the two races is much felt by the reader. From the numerical formulæ of the two races, which are separated by several pages, it is seen that the range of variation in the number of pyloric cæca in the one race is different from that in the other. In the northern form it is 33-61, in the southern 33-52. But it is extremely difficult, by reading and comparing the two lengthy descriptions, to discover what is the exact amount of difference between the two races. However,

© 1888 Nature Publishing Group

after the descriptions we reach a discussion of this very point, and we find that most of the differences on which emphasis has been placed by other authorities are not found to be constant when a large number of specimens are examined, that the two races pass by gradual transition one into the other, but that as a rule in the southern there are fewer pyloric cæca than in the northern, and that the Sewin usually loses the teeth on the body of the vomer, at an earlier age than the northern sea trout.

The following are the different forms of non-migratory fresh-water trout which have been distinguished as distinct species, and whose synonymy is given in the present work: Brook trout, Lochleven trout, Crasspuill trout, Estuary trout, Orkney trout, Cornish trout, Great Lake trout, Gillaroo trout, and Swaledale trout. Short descriptions of these are given in footnotes, excepting the brook trout and the Lochleven trout, which are discussed at length in the text. These descriptions, though brief, are not diagnostic, and it requires the most careful reading and comparison to find in what respects the varieties differ from one another. Mr. Day believes that there is no definite line to be drawn between anadromous sea trout and non-migratory fresh-water trout, intermediate forms being common; nor between the different varieties of fresh-water trout. But granting—for we are inclined to agree with Mr. Day's conclusions—that in all these forms we have but one species, it is surely worth while to give a more lucid and more definite account of the differences between them. The arguments which Mr. Day employs to prove that all forms of trout, whether anadromous or confined to fresh water, belong to one species, may be divided into three classes, and his book would have been much easier to read if he had kept them separate. The first class are those which show that the various forms graduate into one another, or that the peculiarities of one are included in the range of variation of another; the second, those which show that removal to a different environment causes the characteristics of one form to be transmuted into those of another; the third, those which show that the several forms breed freely when crossed.

All the species of char which have been distinguished in Britain are considered in this book as belonging to one variable species which is identical with the *Salmo salvelinus*, Linn., and *S. umbla*, Linn.,—that is, with the Continental char. A similar criticism may be passed on Mr. Day's discussion of char to that made of his account of trout.

In the account of the American char, *Salmo fontinalis*, we have again a minute description, with no specific diagnosis. In a footnote to this portion of the work, it is pointed out that in the article "Salmonidæ" of the present edition of the "Encyclopædia Britannica" the erroneous statement of Dr. Günther, that the *Salmo namaycush* of America is a true trout, is repeated, but no reference is given to any work where the correct description of *S. namaycush* as a char can be found.

We have up to this point been criticizing Mr. Day's work chiefly from a speciegraphical point of view; we must now say a few words about the treatment of other branches of the subject. At the beginning of the account of the genus Salmo is a short description of the anatomy of Salmonoid fishes, followed by a discussion of the eggs and their development, the latter especially in connection with pisciculture at Sir J. Maitland's establishment at Howietoun. The description in the text of the mode of packing eggs which has been perfected at Howietoun seems to be erroneous: it is stated that the main principle is to employ thin layers of well-picked and pressed moss in trays with perforated bottoms, the eggs being separated from the moss by muslin mosquito netting, swan's down, calico, or butter cloth; while in a quotation in a footnote the correct account is given—namely, that the ova rest in direct contact with the damp moss, and are covered by another layer of the same, the muslin being only used in order that the layer of moss may be lifted and moved. Reference is made in this part of the book to the subject of hybridization between different species of Salmo, and a review of the history of the subject is given, but the full treatment of the subject occurs in a chapter specially devoted to it. In this chapter details are recorded of definite experiments in hybridization made at Howietoun. This chapter on hybrids is one of the most interesting in the book, and another on monstrosities is also well worth study.

Scattered throughout the pages are examples of that originality in sentence-construction which is familiar to all who know Mr. Day's writings. Thus in the account of artificial fertilization we read: "This is gently stirred with the hand until the eggs harden, or 'frees' as it is termed, being a period from one to three quarters of an hour according to the temperature, taking longest in cold weather." In another place we find: "One modifying circumstance in the feeding of the salmon has been observed to be connected with a muddy state of the river, possibly interfering with respiration, consequent upon the amount of mud which had been swallowed." Another passage which is worth quoting is:—"As regards thirst it would seem either to be unknown to these creatures; or, living as they do in a watery medium, it may be quenched by means of endosmosis through the skin. Were this not the case, it would be difficult to conceive how such a longing could be satisfied while residing in salt water."

But in spite of its defects the book contains a mass of new and accurate information concerning the forms of Salmonidæ of which it treats. In bibliography it is unusually rich, the results of previous writers being freely quoted in footnotes, so that several of the pages contain 90 per cent. of notes and only 10 per cent. of text. Besides the woodcuts in the course of the work, there are twelve plates of illustrations at the end, ten of which represent different forms of Salmonidæ in beautifully coloured lithographic impressions. The excellence of these is very great, and testifies to great care and skill on the part of the draughtsman (*i.e.* the author himself), the colourist, and the lithographer.

THE ECHINOIDEA.

Die Japanischen Seeigel. Von Dr. L. Döderlein. Pp. 59, Pl. I.–XI., Th. I., Fam. Cidaridæ and Saleniidæ. (Stuttgart: E. Schweizerbart'sche Verlagshandlung, E. Koch, 1887.)

DR. DÖDERLEIN has produced the first part of a very philosophical study of the beautiful Echinoidea, which are in their paradise in the Japanese seas. Some

© 1888 Nature Publishing Group